REMARKS

Applicant acknowledges receipt of an Office Action dated May 21, 2002. In this response, Applicants have amended claims 21-26 and 32. Support for these amendments may be found in the Specification *inter alia* at page 11, lines 5-15. Following entry of these amendments, claims 21-37 are pending in the application.

Applicant respectfully requests reconsideration of the present application in view of the foregoing amendments and in view of the reasons which follow.

Objections to the Specification

On page 2 of the Office Action, the PTO has objected to the Specification under 37 C.F.R. §1.71 for allegedly failing to provide an adequate written description of the invention. The PTO cited various references in the specification to specific claims. In this response, Applicants have amended the Specification to insert the language of the specific claims as originally filed. Applicants submit that these amendments neither broaden nor narrow the scope of disclosure in the specification. In view of the foregoing, Applicants respectfully request reconsideration and withdrawal of the outstanding objection to the Specification.

Rejections Under 35 U.S.C. §112, 2nd Paragraph

On page 2 of the Office Action, the PTO has rejected claims 22, 25 and 32 under 35 U.S.C. §112, 2nd paragraph as allegedly being indefinite. In this response, Applicants have amended these claims to correct the minor typographical errors cited in the Office Action. Reconsideration and withdrawal of the outstanding rejections under §112 is respectfully requested.

Rejections Under 35 U.S.C. §103 – Claims 21-29, 31-33 and 35-37

On page 3 of the Office Action, the PTO has rejected claims 21-29, 31-33 and 35-37 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent 5,458,703 to Nakai (hereafter "Nakai"), JP08-193240 (hereafter "JP '240"), or U.S. Patent 5,972,129 to Beguinot *et al.* (hereafter "Beguinot"). In addition, the PTO has rejected claims 23, 27 and 37 under 35 U.S.C. § 103 as being unpatentable over JP 8246096 (hereafter "JP '096"). Finally, on page 4 of the Office Action, the PTO has rejected claims 30 and 34 under 35 U.S.C. §103 as being unpatentable over any of the references cited *supra* in view of JP09-041076 (hereafter "JP '076") or by JP '076 alone.

To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 180 USPQ 580 (CCPA 1974). See MPEP §2143.03. In this response, Applicants have amended independent claims 21-26 and respectfully traverse the rejections under §103 for the reasons set forth below. Independent claims 21-26 have each been amended specify that "the heat-resisting steel consists essentially of a bainite single phase." Here, none of the references cited by the PTO, taken either individually or in combination, teach or properly suggest a heat resisting steel which "consists essentially of a bainite single phase" as recited in independent claims 21-26. Thus none of these references taken individually or in fair combination can properly render claims 21-26 obvious within the meaning of §103

If an independent claim is nonobvious under §103, then any claim depending therefrom is nonobvious. *In re Fine*, 5 USPQ2d 1596 (Fed. Cir. 1988). See MPEP 2143.03. Thus, claims 27-37, which depend directly from one of the above referenced independent claims, are believed allowable for at least the same reasons.

In rejecting claims 21-37, the PTO has relied upon Nakai, JP '240, Beguinot, JP '096, JP '076). In addition to the foregoing, Applicants respectfully traverse the PTO's rejections for the reasons set forth below.

Nakai

This reference merely discloses a general composition which can be applied to a "non-destructive evaluation method" as stated on lines 35-52 in column 2. The composition range of the steel of this reference is too broad to fully disclose a heat-resisting steel with specific benefits. In fact, all the elements except for C and Cr are optional since no lower limit has been provided for these elements anywhere in the cited reference (see column 2, lines 35-52 of Nakai). Although Nakai discloses aluminum as an optional element, this reference is completely silent and provides no suggestion as to why a person of ordinary skill in the art would exclude aluminum or any information regarding benefits attained by excluding aluminum. These benefits have already been demonstrated in the Rule 132 Declaration filed with Applicants previous response.

Accordingly, Nakai reference fails to teach or fairly suggest a heat-resisting steel having the specific composition defined in claims 21-26.

In addition, Nakai fails to teach or fairly suggest a metal structure of a bainite single phase, which contributes to the textural stability and properties as described hereinafter.

JP '240

Although the PTO appears to regard aluminum as an optional element in this reference, Applicants note that aluminum is disclosed as an essential element in this reference. All of the steels, A-I, employed in the Examples of this reference contain aluminum, and aluminum-free steel cannot be found anywhere in this reference (see Table 1). In addition, in paragraph [0024], the following description is found:

> "Aluminum is important element in deoxidizing steels, deoxidizing is also carried out by silicon or titanium. In view of this, in order to prevent it (rare metal) from being oxidized as well as to effectively ensure solid dissolution x at a level of not less than 1 ppm, the aluminum content should be not less than 0.010%. On the other

hand, when the aluminum content is more than 0.20%, cleanness and welding reactivity of welding metal is deteriorated by intermediates. Accordingly, the content of aluminum is limited to 0.010 to 0.20%." (Applicants translation of passage from paragraph [0024] of JP '240)

This description, taken together with the Examples, appears to indicate that aluminum is an essential element in this reference. Accordingly, this reference teaches away from the present invention, inasmuch as it discloses aluminum as an essential element in deoxidizing steel and fails to suggest the benefits by excluding aluminum, which have already been demonstrated in our previous response based on Rule 132 Declaration. The steels of this citation also contains REM, yttrium, and zirconium, however, these elements have been excluded in the present inventions by the use of the transitional phrase "consisting essentially of". This reference therefore fails to teach or fairly suggest a beat-resisting steel without aluminum, REM, yttrium, and zirconium as in the present invention and the benefits attained thereby.

In addition, this reference also fails to teach or fairly suggest a metal structure of a bainite single phase, which contributes to the textural stability and properties as described hereinafter.

Beguinot

As with Nakai above, Beguinot merely discloses a general composition for smelting a titanium steel, and the composition range of the steel of this reference is too broad to fully disclose a heat-resisting steel with specific benefits. In fact, all the elements except for N and Ti are optional given that the lower limits of these elements are zero (see, for example, claims 15-18 in Beguinot).

Moreover, although Beguinot discloses aluminum as an optional element, this reference is completely silent as to what benefits are attained by excluding aluminum. These benefits have been described in the Rule 132 Declaration filed with the previous response. Accordingly, Beguinot fails to

teach or fairly suggest a heat-resisting steel having the specific composition defined in claims 21-26 and benefits thereby.

In addition, Beguinot fails to teach or fairly suggest the metal structure of a bainite single phase, which contributes to the textural stability and properties as described hereinafter.

JP '096

The steels disclosed in JP '096 are clearly different from those of the present invention in two alternative respects, i.e., based on the absence of the claimed carbon content of more than 0.2% (see current claims 21-23) or based on the absence of molybdenum (see current claims 24-26).

Further, this reference also fails to teach or suggest a metal structure in which the heat-resisting steel consists essentially of a bainite single phase as recited in amended claims 21-26. In this respect, Applicants submit that a bainite single phase cannot be attained according to the method described in paragraph [0019] of this reference. In this paragraph [0019], the following description is found.

> "Steels I3 to N5 of the present invention was heated at 1040C° for an hour, followed by air-cooling. After the air cooling, the steels were retained for an hour at three different tempering temperature, which was changed between 650-690C° by 20C°, and then subjected to air-cooling."

According to this description, one skilled in the art would recognize that the steels obtained in this reference do not have a bainite single phase because air-cooling is carried out instead of oil-cooling. As shown in Table 3 of the present specification, oil-cooling is an important process for attaining a bainite single phase, which contributes to the textural stability and properties. In contrast, the results in Table 3 for air-cooling show that it is less likely to form a single bainite phase, and rather likely to form a ferrite

phase which exerts adverse effects on the textural stability and properties (see page 7, lines 12-27 in the present specification).

In this respect, with regard to claims 21-23, it should be pointed out that the carbon content of more than 0.2% contributes to the textural uniformity, especially in large-bulk steels. In the case where the carbon content is less than 0.2%, however neither oil-cooling nor air-cooling can produce a bainite single phase. Accordingly, the steels of the citation contain carbon of less than 0.2%, and this composition makes it more difficult to form a single bainite phase in JP '096.

On the other hand, with regard to claims 24-26, Applicants note that molybdenum contributes to an improvement in hardenability, in addition to the benefits stated on page 5, lines 1-8 in the present specification. If hardenability is worse, an unfavorable ferrite is more likely to form. In this respect, since the steels of claims 24-26 contain molybdenum which improves hardenability, the lower limit of carbon content of claims 24-26 is lowered to 0.15% accordingly compared with claims 21-23 without preventing the formation of a single bainite phase.

As explained above, in the present invention, the composition of the steels is specified to attain a bainite single phase. Now that the metal structure of a bainite single phase is clearly recited in the amended claims, Applicants submit that JP '096 fails to teach or fairly suggest the heat-resisting steels of the present invention.

<u>JP '076</u>

Firstly, Applicants note that the English Abstract of this reference <u>appears to contain a typographical error</u>. That is, the recitation "<0.6% Si (less than 0.6% of silicon" found in the Abstract should be read as "<0.05 Si (less than 0.05% of silicon)" as clearly stated in claim 1 and paragraph [0007] of this reference.

The steels disclosed in this reference are clearly differentiated from those of present invention by silicon content of more than 0.05% and nitrogen content of more than 0.001% or 0.005% while this reference disclose silicon content of less than 0.05%, the steels of the present invention contains silicon of more than 0.05%. This reference further fails to disclose the presently claimed nitrogen range of more than 0.001% or 0.005%. Applicants therefore submit that this reference fails to teach or fairly suggest a heat-resisting steel of the presently claimed invention.

In addition, this reference also fails to teach or suggest the metal structure of a bainite single phase, which contributes to the textural stability and properties as described hereinbefore.

In view of the foregoing, Applicants respectfully request reconsideration and withdrawal of the outstanding rejections under §103.

CONCLUSION

Applicant believes that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

Respectfully submitted,

Date October 21, 2002

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MARKED UP VERSION SHOWING CHANGES MADE

Below are the marked up replacement paragraphs:

Below are the marked up replacement paragraph(s):

Page 8, paragraph starting at line 7:

This example is to show that the first and second heat-resisting steels having the chemical compositions [as defined in claims 1 and 2 of the present invention] comprising 0.15-0.30 wt. % C, 0.05-0.3 wt. % Si, 0.01-0.7 wt. % Mn, 1.8-2.5 wt. % Cr, 0.15-0.23 wt. % V, 1.5-2.5 wt. % W, 0.01-0.02 wt. % Ti, 0.01-0.08 wt. % Nb, 0.005-0.03 wt. % N, 0.001-0.015 wt. % B, and Fe and unavoidable impurities as the remainder or comprising 0.15-0.30 wt. % C, 0.05-0.3 wt. % Si, 0.01-0.7 wt. % Mn, 1.8-2.5 wt. % Cr, 0.15-0.23 wt. % V, 1.5-2.5 wt. % W, 0.3-0.8 wt. % Mo, 0.01-0.02 wt. % Ti, 0.01-0.08 wt. % Nb, 0.005-0.03 wt. % N, 0.001-0.015 wt. % B, and Fe and unavoidable impurities as the remainder, respectively, have excellent properties.

Page 8, paragraph starting at line 17:

Of the heat-resisting steels shown in the table, P1 to P8 are heat-resisting steels whose chemical compositions fall in the ranges [defined in claim 1 or 2 of the present invention] comprising 0.15-0.30 wt. % C, 0.05-0.3 wt. % Si, 0.01-0.7 wt. % Mn, 1.8-2.5 wt. % Cr, 0.15-0.23 wt. % V, 1.5-2.5 wt. % W, 0.01-0.02 wt. % Ti, 0.01-0.08 wt. % Nb, 0.005-0.03 wt. % N, 0.001-0.015 wt. % B, and Fe and unavoidable impurities as the remainder or comprising 0.15-0.30 wt. % C, 0.05-0.3 wt. % Si, 0.01-0.7 wt. % Mn, 1.8-2.5 wt. % Cr, 0.15-0.23 wt. % V, 1.5-2.5 wt. % W, 0.3-0.8 wt. % Mo, 0.01-0.02 wt. % Ti, 0.01-0.08 wt. % Nb, 0.005-0.03 wt. % N, 0.001-0.015 wt. % B, and Fe and unavoidable impurities as the remainder (in this example, referred to as the heat-resisting steels of the present invention), and C1, C2, C4 and C5 are heat-resisting steels whose chemical compositions are not within [the] these ranges [defined in claim 1 or 2 of the

present invention] (hereinafter referred to as the comparative heat-resisting steels). All of these steels have been controlled to have a tensile strength of approximately 750 MPa.

Page 9, paragraph starting at line 5:

This example is to show that the third and fourth heat-resisting steels having the chemical compositions as defined[in claims 3 and 4 of the present invention] in the preceeding example but wherein all of Nb and a part of Fe are replaced with V and/or Ti to make the V content 0.23 (exclusive)-0.35 wt, %, and the Ti content 0.02 (exclusive)-0.03 wt. %, the heat-resisting steel thus containing no Nb other than that existing as the impurity or wherein all of Nb and Ti, and a part of Fe are replaced with V to make the V content 0.23 (exclusive)-0.35 wt. %, the heat-resisting steel thus containing no Nb and Ti other than those existing as the impurities, respectively, have excellent properties.

Page 9, paragraph starting at line 12:

Of the heat-resisting steels shown in the table, P9 to P18 are heat-resisting steels whose chemical compositions are in the ranges [defined in claim 3 or 4 the present invention] of the preceeding example, but wherein all of Nb and a part of Fe are replaced with V and/or Ti to make the V content 0.23 (exclusive)-0.35 wt, %, and the Ti content 0.02 (exclusive)-0.03 wt. %, the heat-resisting steel thus containing no Nb other than that existing as the impurity or wherein all of Nb and Ti, and a part of Fe are replaced with V to make the V content 0.23 (exclusive)-0.35 wt. %, the heat-resisting steel thus containing no Nb and Ti other than those existing as the impurities or (in this example, referred to as the heat-resisting steels of the present invention); and C1-C3, C6 and C7 are comparative heat-resisting steels whose chemical compositions are not in the ranges set forth [in claim 3 or 4 of the present invention] above. All of these heat-resisting steels have been controlled to have a tensile strength of approximately 750 MPa.

Page 9, paragraph starting at line 36:

This example is to show that the fifth and sixth heat-resisting steels having the chemical compositions [as defined in claims 5 and 6 of the present invention] of the preceeding example but wherein a part of Fe is replaced with Ni to make the Cu content 0.1-3.0 wt. % or wherein a part of Fe is replaced with Cu to make the Cu content 0.1-3.0 wt. %, respectively, have excellent properties.

Page 10, paragraph starting at line 6:

Of the heat-resisting steels shown in the table, P19 to P24 are heat-resisting steels whose chemical compositions fall in the ranges [defined in claim 5 or 6 of the present invention] of the preceeding example but wherein a part of Fe is replaced with Ni to make the Cu content 0.1-3.0 wt. % or wherein a part of Fe is replaced with Cu to make the Cu content 0.1-3.0 wt. % (in this example, referred to as the heat-resisting steels of the present invention); and C1-C9 are heat-resisting steels whose chemical compositions do not fall in [the] these ranges[defined in claim 5 or 6 of the present invention](hereinafter referred to as the comparative heat-resisting steels). All of these heat-resisting steels have been controlled to have a tensile strength of approximately 750 MPa.

Page 14, paragraph starting at line 3:

The heat-resisting steels [whose chemical compositions are in the ranges defined in the claims] of the present invention, and steam turbine rotors made of the heat-resisting steels of the invention that have been treated by the heat treatment method according ti the present invention are excellent in both high-temperature strength and impact properties. The present invention can thus improve the performance, operation characteristics and profitability of steam turbine rotor showing that the present invention is industrially advantageous.

Below are the marked up amended claim(s):

21. (Amended) A heat-resisting steel consisting essentially of 0.20 (exclusive) – 0.30 wt.% C, 0.05 (exclusive) - 0.30 wt.% Si, 0.01 - 0.7 wt.% Mn, 1.8 – 2.5 wt.% Cr, 0.15 - 0.23 wt.% V, 1.5 – 2.5 wt.% W, 0.01 - 0.02 wt.% Ti, 0.01 - 0.08 wt.% Nb, 0.005 - 0.03 wt.% N, 0.001 - 0.015 wt.% B, and Fe and unavoidable impurities as the remainder, wherein the heat-resisting steel consists essentially of a bainite single phase.

22. (Amended) A heat-resisting steel consisting essentially of 0.20 (exclusive) – 0.30 wt.% C, 0.05 (exclusive) - 0.30 wt.% Si, 0.01 - 0.7 wt.% Mn, 1.8 – 2.5 wt.% Cr, [0.15 - 0.23 wt.% V,] 1.5 – 2.5 wt.% W, 0.23 (exclusive) – 0.35 wt.% V, 0.02 (exclusive) - 0.03 wt.% Ti, 0.005 - 0.03 wt.% N, 0.001 - 0.015 wt.% B, and Fe and unavoidable impurities as the remainder, wherein the heat-resisting steel consists essentially of a bainite single phase.

23. (Amended) A heat-resisting steel consisting essentially of 0.20 (exclusive) – 0.30 wt.% C, 0.05 (exclusive) - 0.30 wt.% Si, 0.01 - 0.7 wt.% Mn, 1.8 – 2.5 wt.% Cr, 0.23 (exclusive) – 0.35 wt.% V, 1.5 – 2.5 wt.% W, 0.005 - 0.03 wt.% N, 0.001 - 0.015 wt.% B, and Fe and unavoidable impurities as the remainder, wherein the heat-resisting steel consists essentially of a bainite single phase.

24. (Amended) A heat-resisting steel consisting essentially of 0.15 – 0.30 wt.% C, 0.05 (exclusive)- 0.30 wt.% Si, 0.01 - 0.7 wt.% Mn, 1.8 – 2.5 wt.% Cr, 0.15 - 0.23 wt.% V, 1.5 – 2.5 wt.% W, 0.3 – 0.8 wt.% Mo, 0.01 - 0.02 wt.% Ti, 0.01 - 0.08 wt.% Nb, 0.005 - 0.03 wt.% N, 0.001 - 0.015 wt.% B, and Fe and unavoidable impurities as the remainder, wherein the heat-resisting steel consists essentially of a bainite single phase.

25. (Amended) A heat-resisting steel consisting essentially of 0.15 – 0.30 wt.% C, 0.05 (exclusive)- 0.30 wt.% Si, 0.01 - 0.7 wt.% Mn, 1.8 – 2.5 wt.% Cr, [0.15 - 0.23 wt.% V,] 1.5 – 2.5 wt.% W, 0.3 – 0.8 wt.% Mo, 0.01 - 0.02 wt.% Ti, 0.23 (exclusive) – 0.35 wt.% V, 0.02 (exclusive) - 0.03 wt.% Ti, 0.005 - 0.03 wt.% N, 0.001 - 0.015 wt.% B,

and Fe and unavoidable impurities as the remainder, wherein the heat-resisting steel consists essentially of a bainite single phase.

26. (Amended) A heat-resisting steel consisting essentially of 0.15 – 0.30 wt.% C, 0.05 (exclusive) - 0.30 wt.% Si, 0.01 - 0.7 wt.% Mn, 1.8 – 2.5 wt.% Cr, 0.23 (exclusive) – 0.35 wt.% V, 1.5 – 2.5 wt.% W, 0.3 – 0.8 wt. % Mo, 0.005 - 0.03 wt.% N, 0.001 - 0.015 wt.% B, and Fe and unavoidable impurities as the remainder, wherein the heat-resisting steel consists essentially of a bainite single phase.

32. (Amended) The heat-resisting steel according to claim 26, which further comprises 0.1-3.0 [st.%] wt.% Cu.